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Joint ICTP-IAEA School of Nuclear Energy Management

5 - 23 November 2012

Knowledge Management and Safety Performance in NPPs

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International Atomic Energy Agency

Knowledge Management and Safety Performance in NPPs

20-November

5th Nuclear Energy Management School
2012 Trieste Italy

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Nuclear Knowledge Management
Department of Nuclear Energy

History shows us knowledge can be lost!

An example: Ancient Roman ruins under Vienna had integrated aqueducts and sewage systems!

LEGIONARY FORTRESS

In Roman times, there were schematic architectural regulations for planning and laying out a legionary fortress. That makes it easier today to locate the most important buildings and reconstruct the ground plans within dense built-over areas – as was also the case in Vienna. The outlines of the legionary fortress, which were enclosed by massive walls with towers and three ditches, can still be seen in the current city landscape (Tiefer Graben – Naglergasse – Graben – Rotenturmstraße). The legionary gates were connected with each other through roads laid out along the axis. Here, the main buildings were located: the command headquarters, the palace of the legion commander, the houses of the officers, and the baths. Living quarters for troops, a hospital, workshops, and stables, were set up in a right-angled grid.



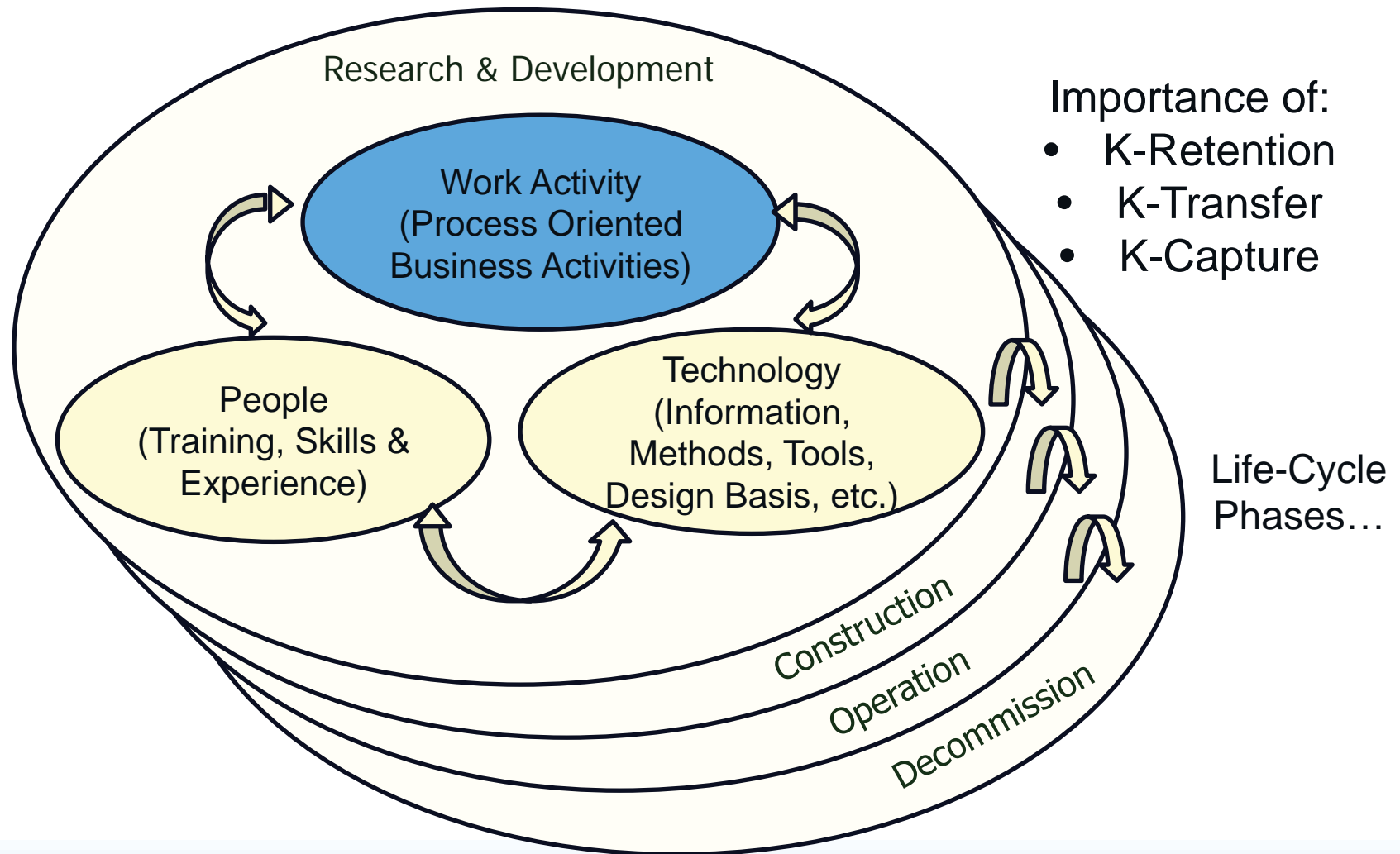
History shows us knowledge can be lost! (2)

Another example: Construction methods of older churches in Europe have been lost!

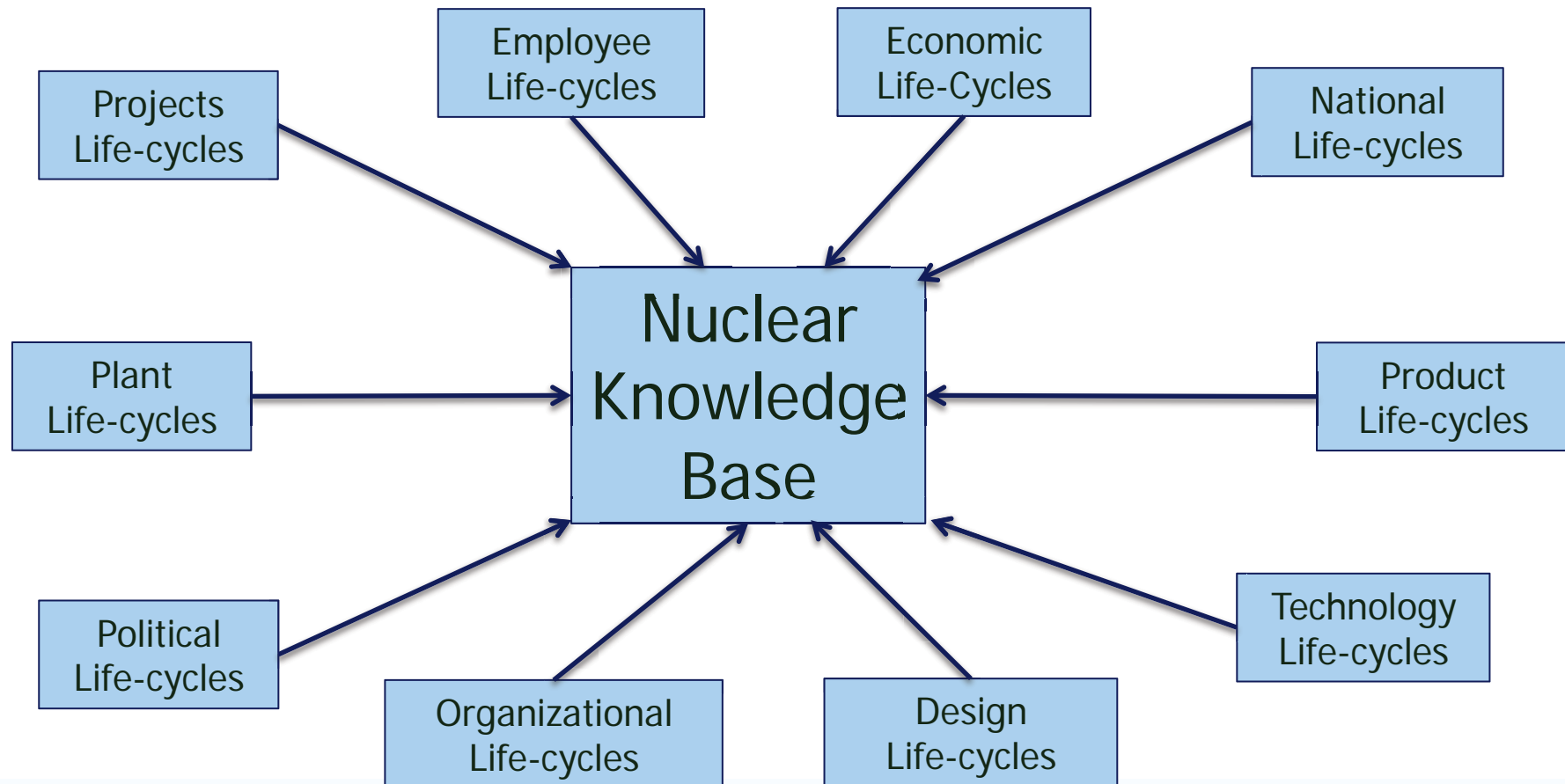
Risk of Knowledge Loss in Nuclear Organizations is Real



Maintaining nuclear knowledge and competence over the life-cycle



Threats to the Nuclear Knowledge Base (occur on many life-cycle dimensions)



Barriers to Resolution

- **Financial**
- **Ownership (perceived responsibility)**
- **Intellectual property**
- **Resource limitations**
- **Awareness (importance)**
- **Support (perceived priority)**
- **Time available (and urgency)**
- **Manageability**



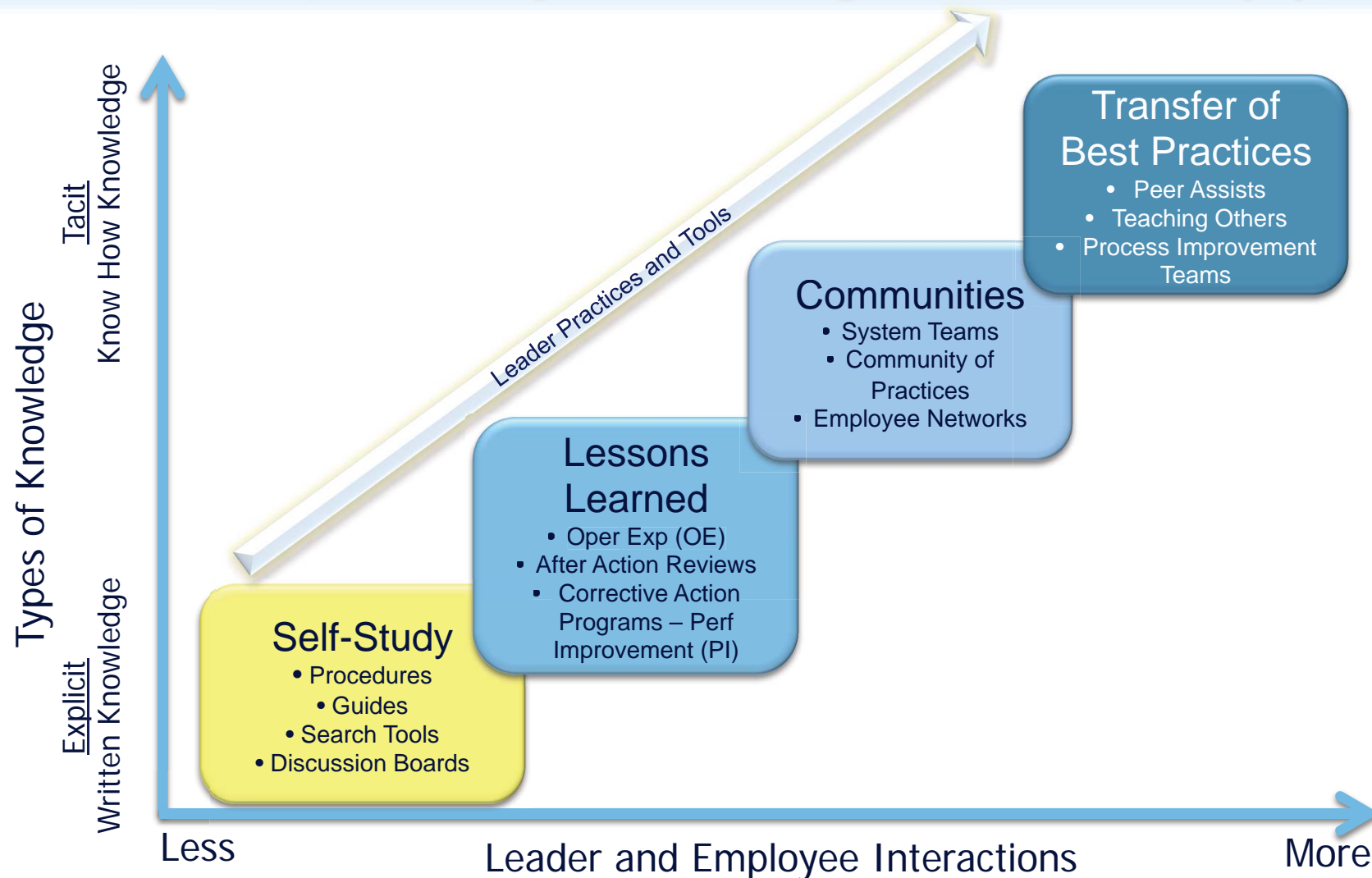
Competency Building Timelines (1)



Adapted from David Heler – Palo Verde Human Resources



Competency Building Timelines (2)



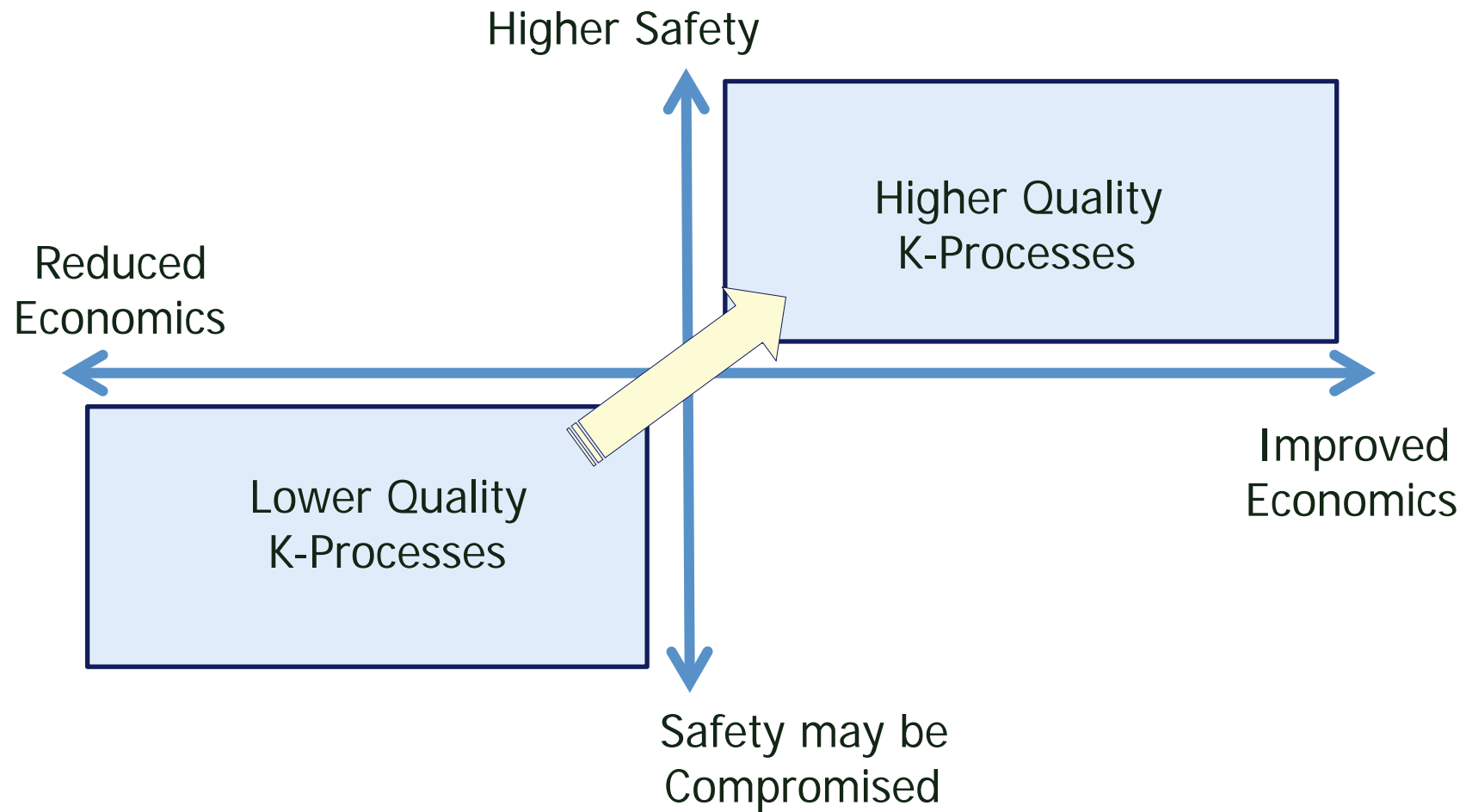
Adapted from David Heler – Palo Verde Human Resources



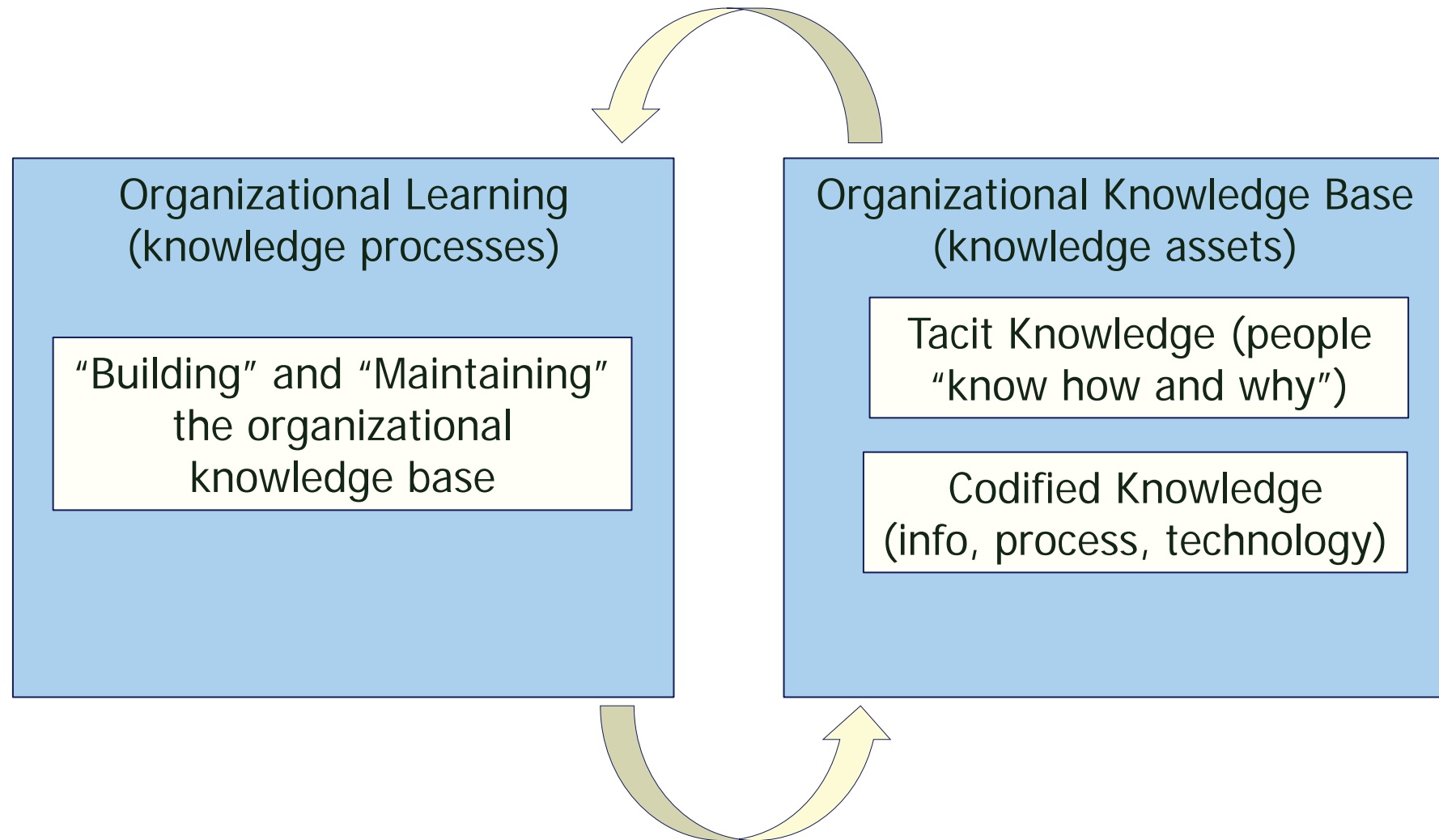
Linking KM to Safety in Nuclear Organizations



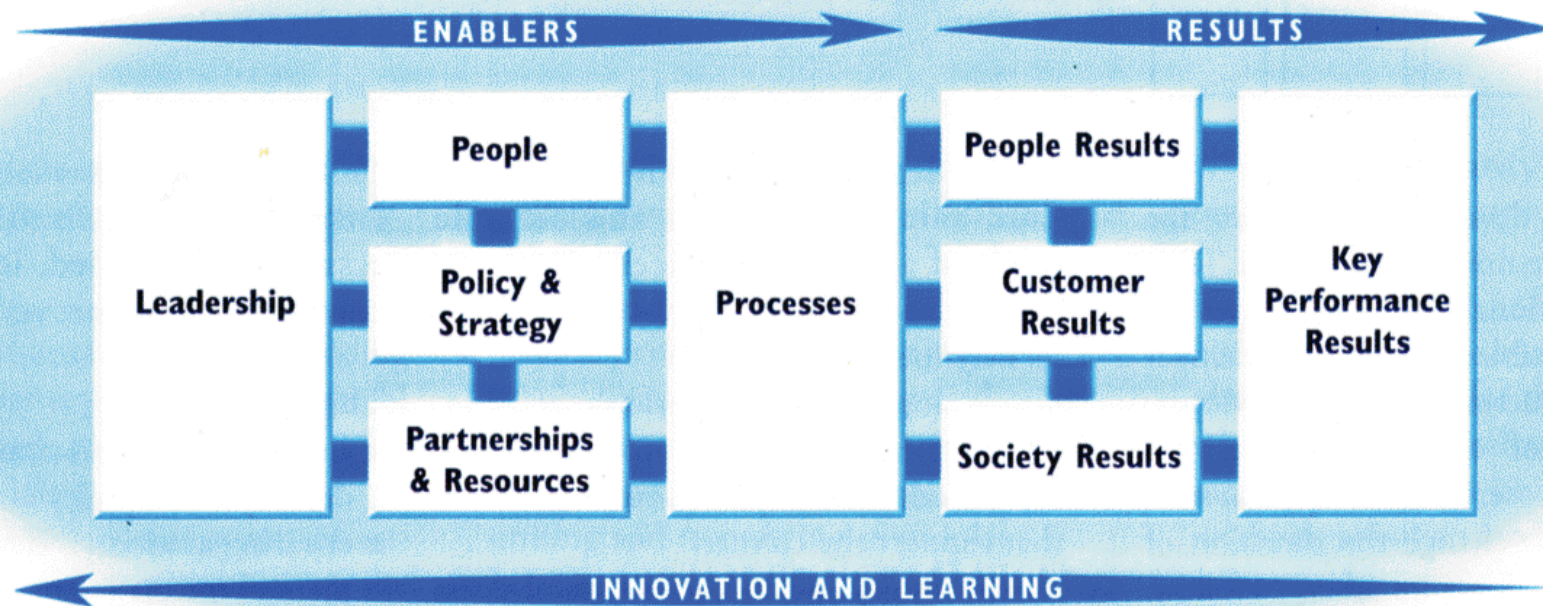
Expected Impact of KM on Nuclear Facilities



Basic Elements of a KMS



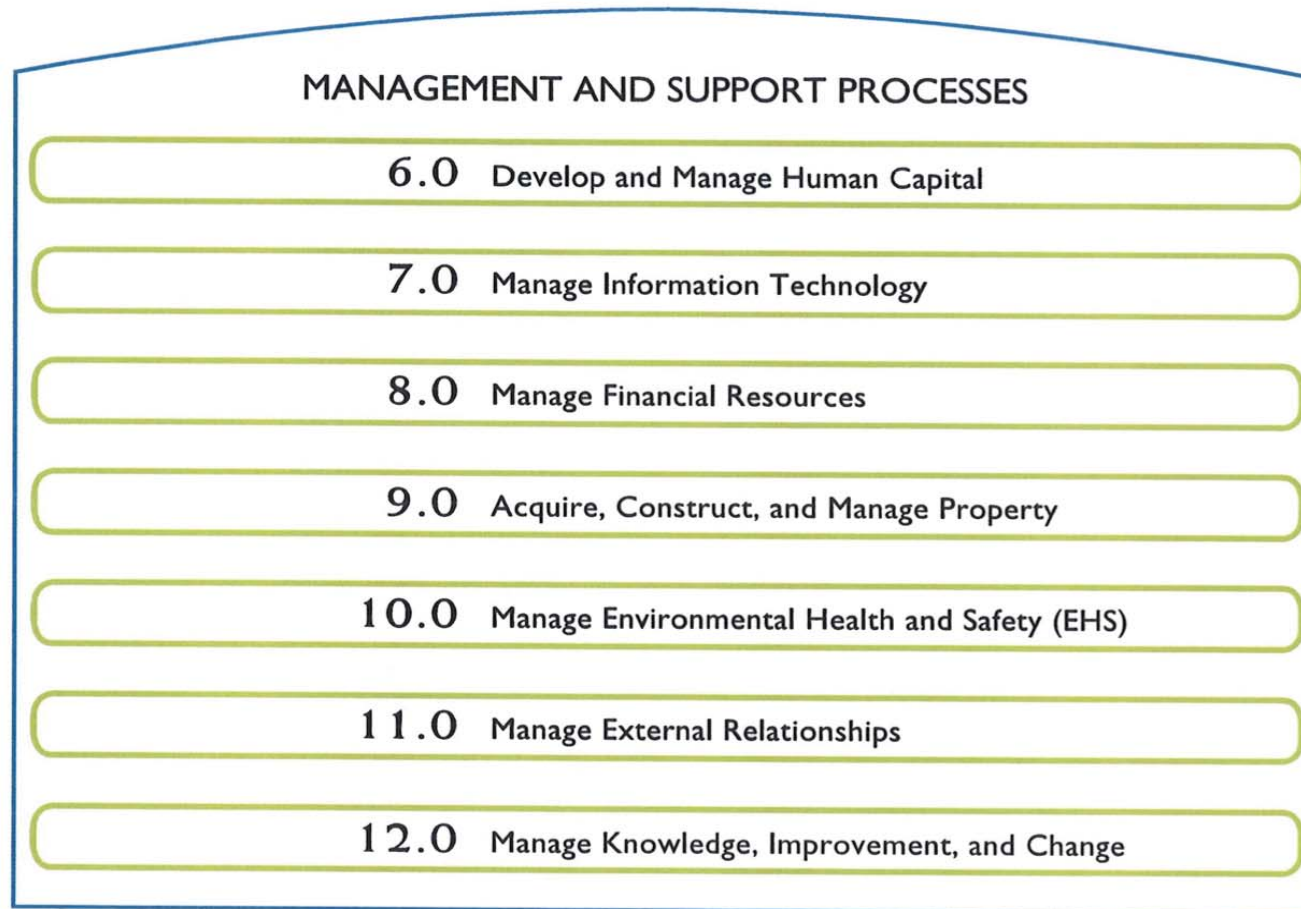
Quality Management Systems Perspective on Organizational Performance



© 1999 - 2003 EFQM



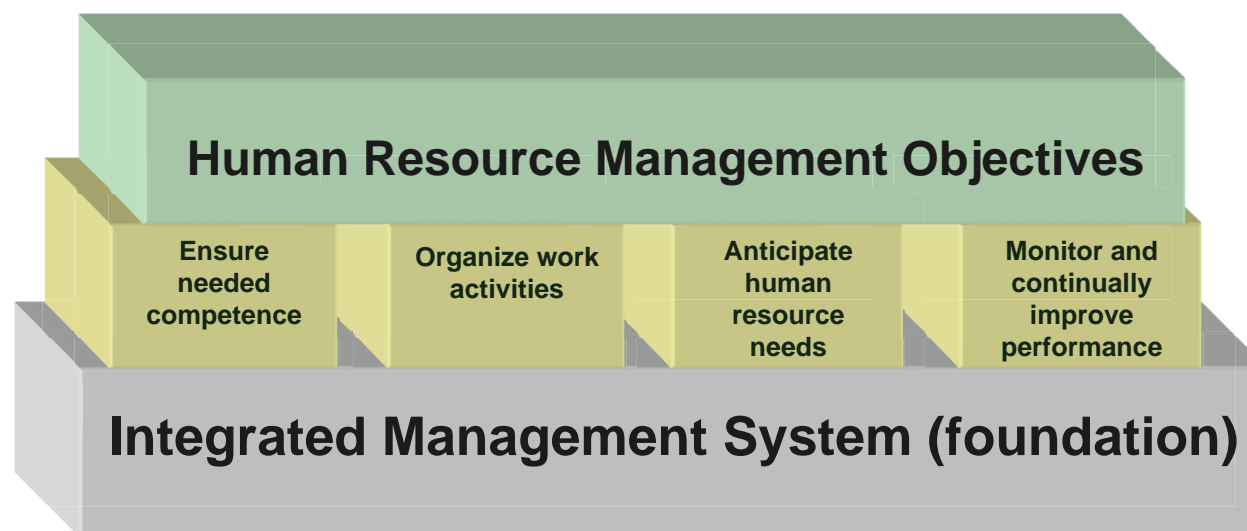
Quality Management Systems Perspective on Management and Support Functions



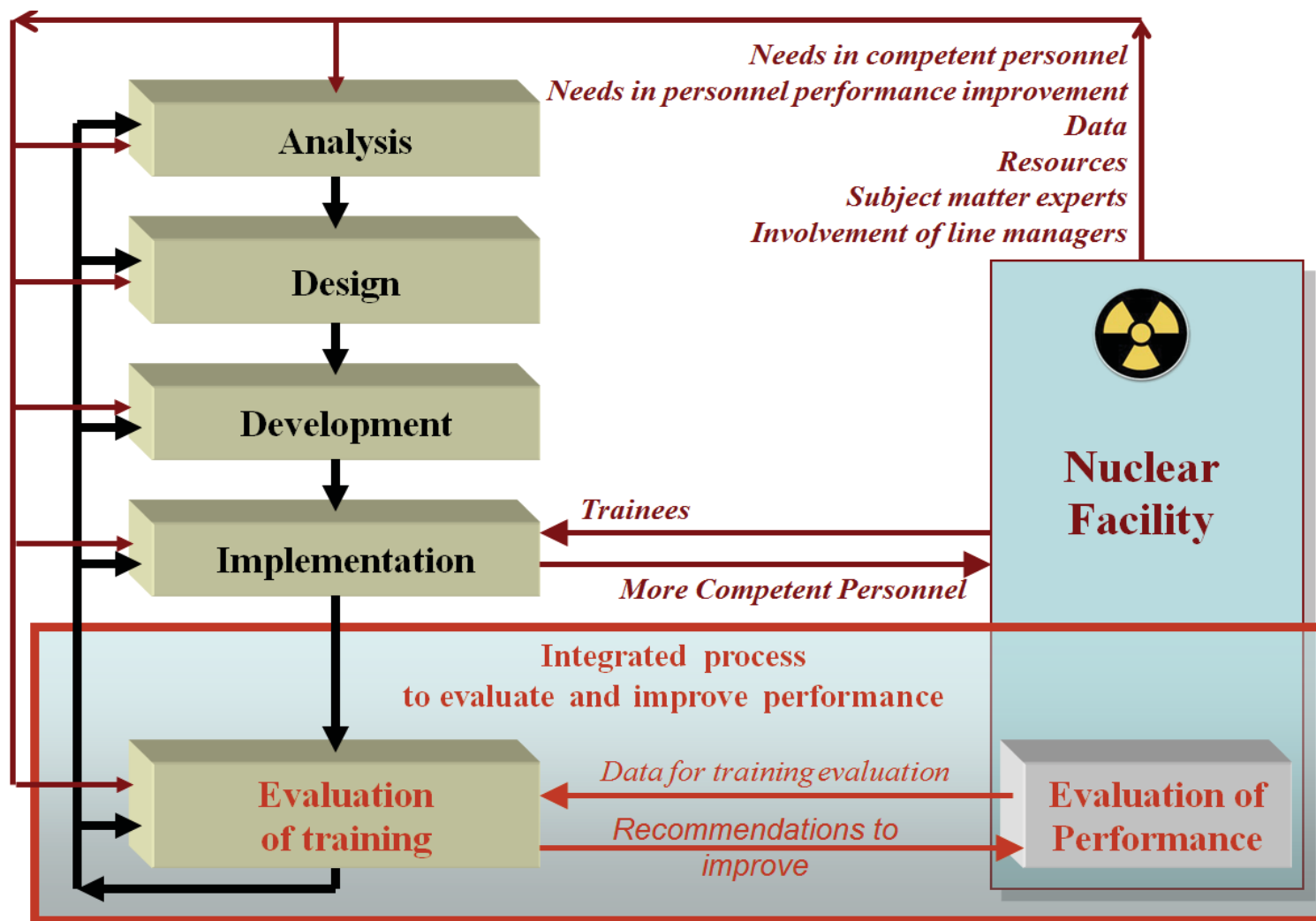
Adapted from APQC Standard Processes Diagram



Traditional View of HRM



Example of Knowledge-driven Management System: SAT-based Training Program



NPP Management Systems

- Design basis configuration management
 - Design change control & approval
- Equipment qualification program (environmental qualification, condition assessment)
- Equipment reliability program
- Life-cycle nuclear asset management program
- Licensing compliance
- Operations
- Training program
- Human resource management program
- Nuclear Quality Assurance program
- Worker protection (occupational health and safety programs)
- Supply chain management program
- Operating experience feedback system
- Waste Fuel management
- Performance management program
- External liaison and stakeholder communications
- Corrective action processes
- Plant maintenance (condition based maintenance, reliability centred maintenance. Preventive maintenance)
- Outage planning
- Work management systems
- IT/IS support processes
- Planning processes
- In-service testing program
- Information and records management
- Reactivity management
- Radiation protection program
- Site security
- Emergency response program
- Etc.



What drives organizational competency requirements?

Strategic
Perspective

Employee
Perspective

Workforce Supply
Perspective

Projects
Perspective

Social/Behavioural/
Relationship Skills
Perspective

Career
Perspective

External Demands
Perspective

Major Process
Perspective

Organizational
Design/Structure

Position
Perspective

External Services
Perspective

Job Design
Perspective

Future Competency
Needs Perspective

Programs
Perspective

Organizational Culture
Perspective

Technology Base
Perspective

Life-cycle
Perspective

Discipline
Perspective

KM
Perspective

Regulatory
Perspective

Technology Support
Perspective

Departmental
Perspective

Quality
Perspective

Innovation
Perspective

Organizational
Learning
Perspective

Workforce Planning
Perspective



Other Considerations

- View of organizational competency requirements as a “*demand/supply flow model*” perspective
- View as balance of capability “*specialization verses generalization*”
- View organizational capabilities in terms of “*depth of capability verses allocation verses demand*”
- View of what future organizational capability map looks like and how to get there?



Other considerations (cont'd)

- Stability of external drivers (strategic goals, external demand, uncertainty, etc.)
- Stability of internal drivers (type of organization)
- External constraints (obligations)
- External risks (uncertainty, failure)
- External opportunities (positioning)
- Knowledge loss risk perspective
- Knowledge building barriers perspective



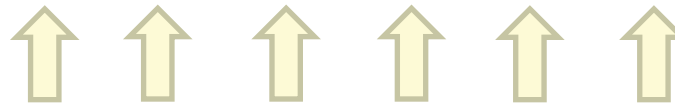
Mission
Vision and
Strategy



What defines success for our organization?



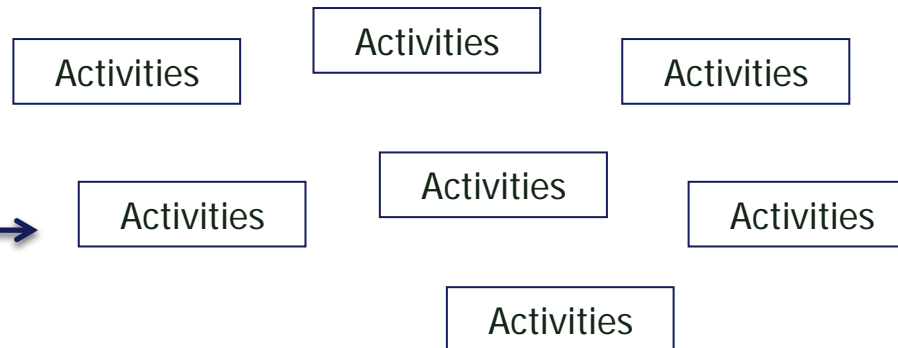
What do we need to be good at?



*Business functions
Major processes
Core competencies*

*What happens?
What needs to happen?
What resources needed?*

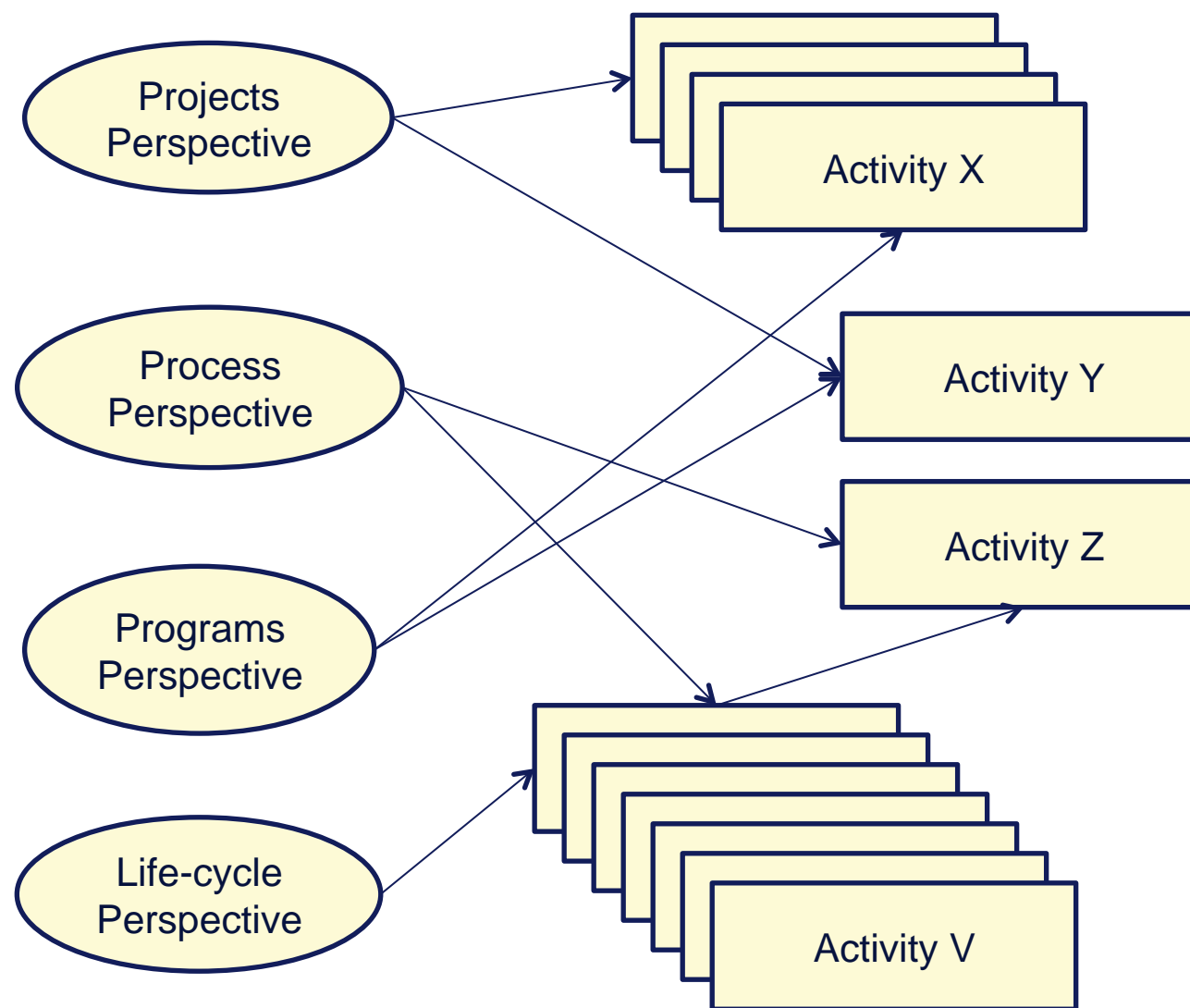
- Human
- Technology
- Other?



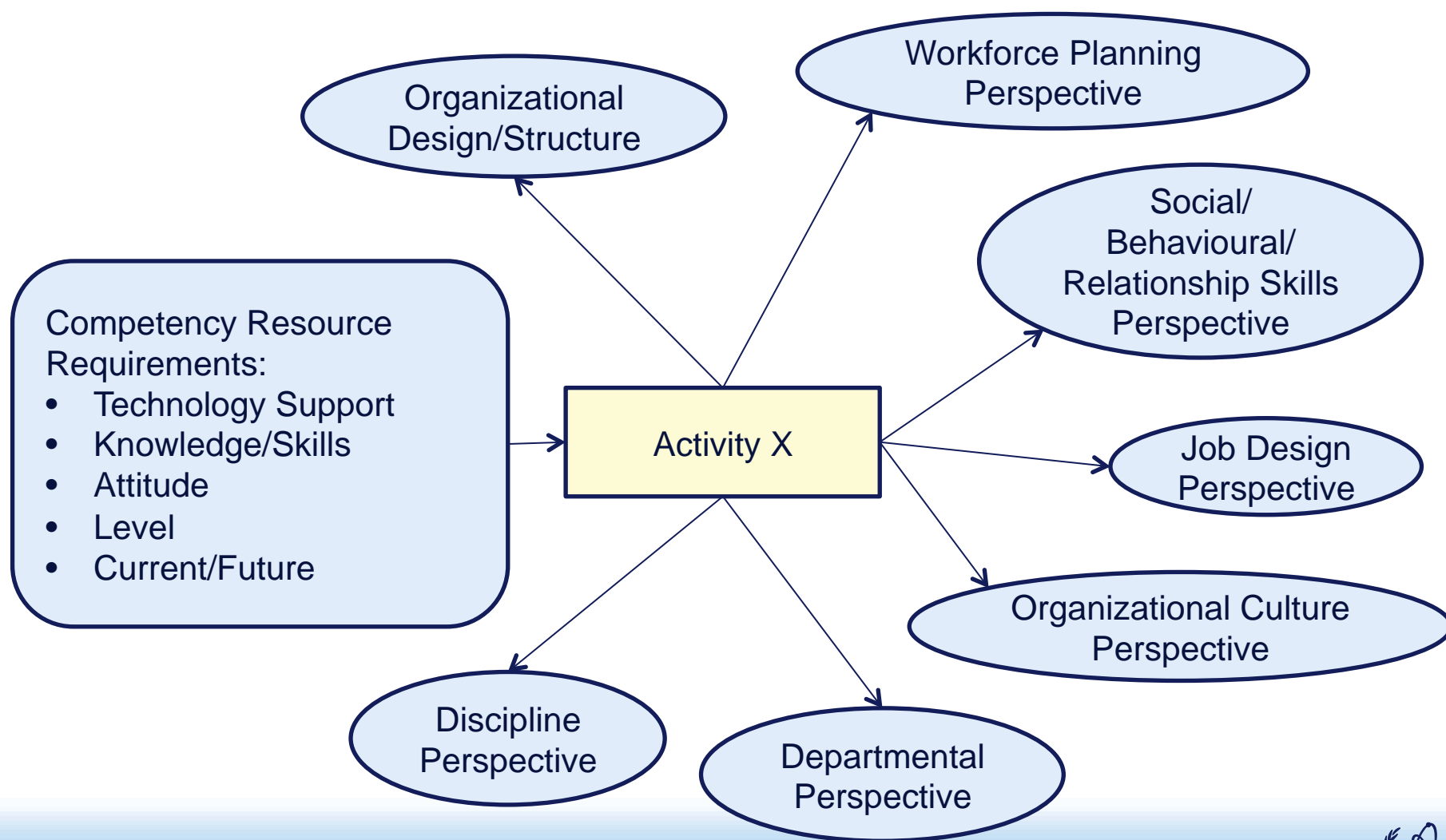
- Evaluate current
- Define future
- Identify gaps



Drivers of demand for work (examples)

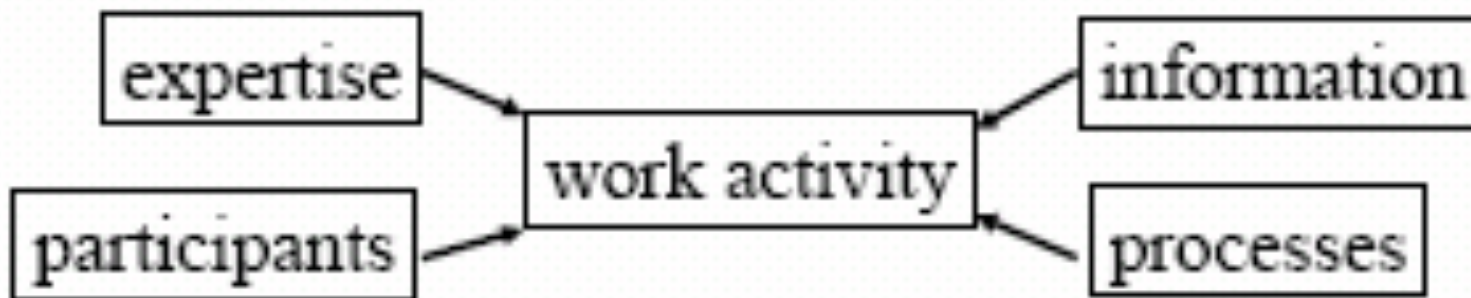


Competency Requirements a Function of Work Activity



KM Thinking Applied to Work Activity

- What are the critical K-processes?
- What are the characteristics of the relevant knowledge needed?
- Who has or should have this knowledge?
- What mechanisms are needed for the generation and utilization of this knowledge?
- What organizational conditions, processes, and changes are needed to make it work?



Workflow Analysis Considerations (examples)

- Processes defined and understood
- Decision processes
- Complexity
- Competencies required
- Stakeholders (owner, producer, consumer, maintainer)
- Verification processes
- Records
- Knowledge capture and retention
- Knowledge transformation
- Knowledge utilization
- Knowledge transfer & sharing
- Knowledge acquisition & adoption
- Approval processes
- Validation processes
- Feedback and learning processes
- Knowledge integration
- Technology support for work process
- Data/information inputs
- Data/information outputs
- Embedded methodology
- Decision/work sequences
- Safety issues
- Economic issues
- Risk issues
- Responsibility
- Review and feedback
- Corrective actions
- Security
- Training
- Data integration
- Knowledge resources

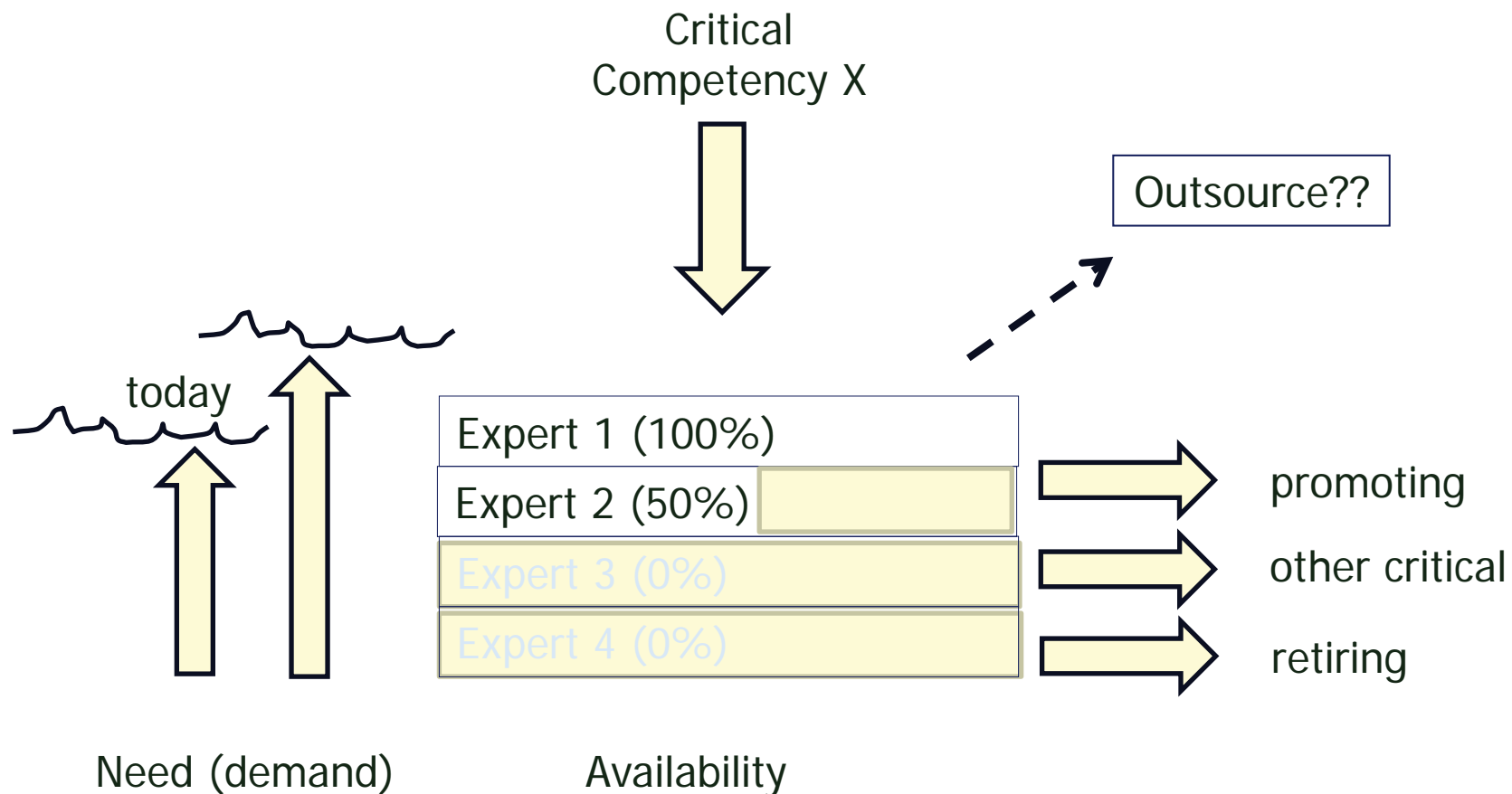


Information and Data Management Considerations (examples)

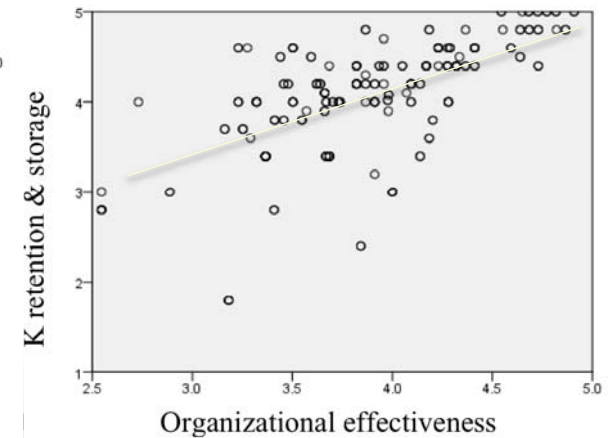
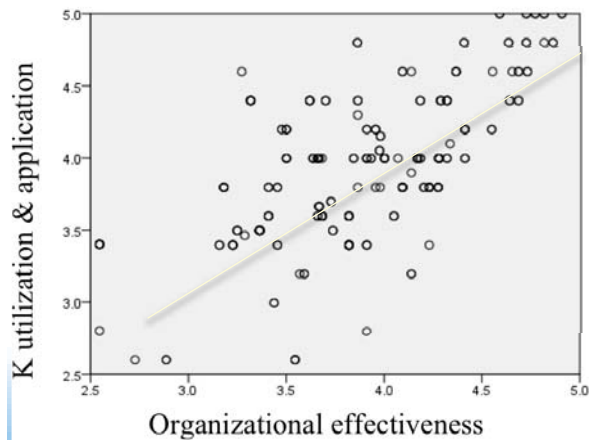
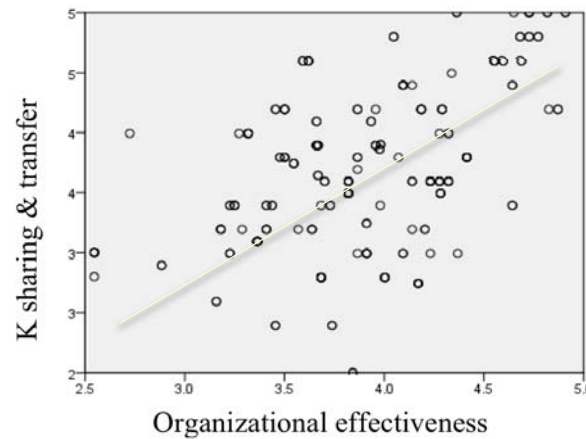
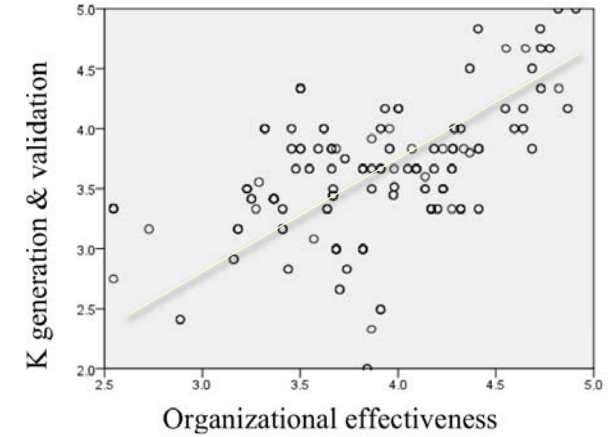
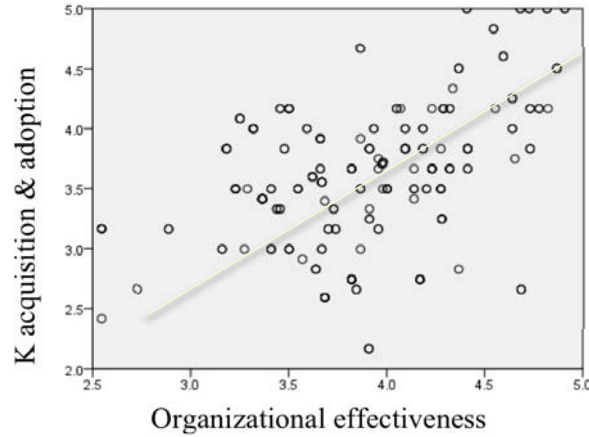
- Sensitivity
- Validation
- Production
- Ownership
- Maintenance
- Access
- Security
- Permanence
- Users
- Distribution
- Archival
- Storage and retrieval
- Organization
- Structure
- Interchange
- Completeness
- Consistency
- Correctness
- Clarity
- Language
- Terminology
- Classification
- Taxonomy
- Formats
- Conversion
- Level of detail
- Time sensitivity
- Safety-related
- Importance (criticality, cost to replace)



Organization-wide Competency Demand



Links between Knowledge Processes and Organizational Effectiveness



NEM School 2012 - Trieste

Links between Knowledge Management Practices and Supportive Organizational Culture

Figure 1. Scatterplot of SOC vs. SOL

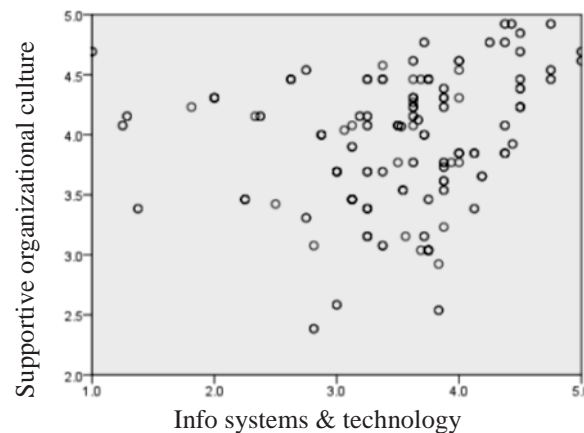
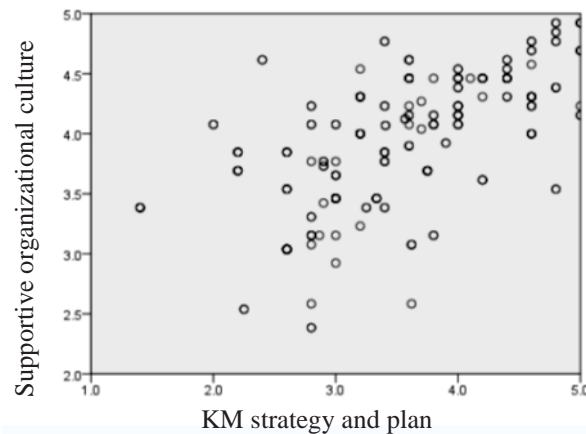
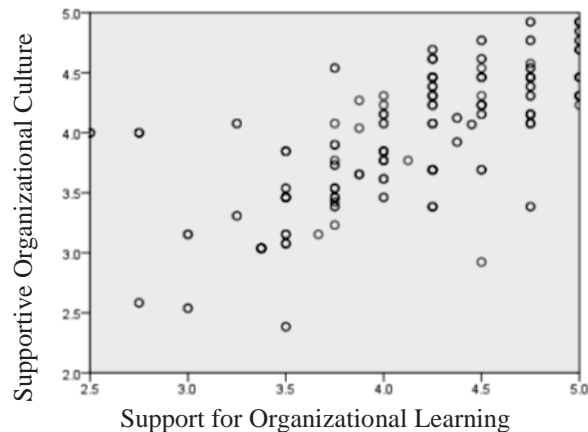
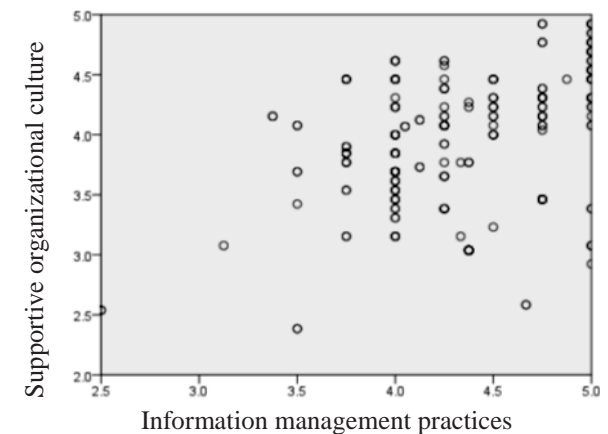
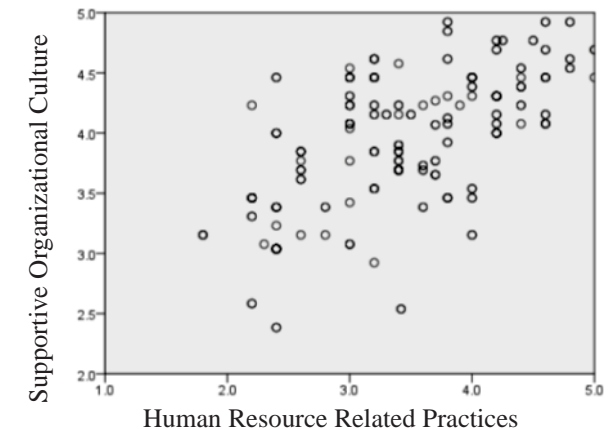


Figure 1. Scatterplot of SOC vs. HRP



Links between Supportive Organizational Culture and Knowledge Processes

Figure 1. Scatterplot of SOC vs. KA

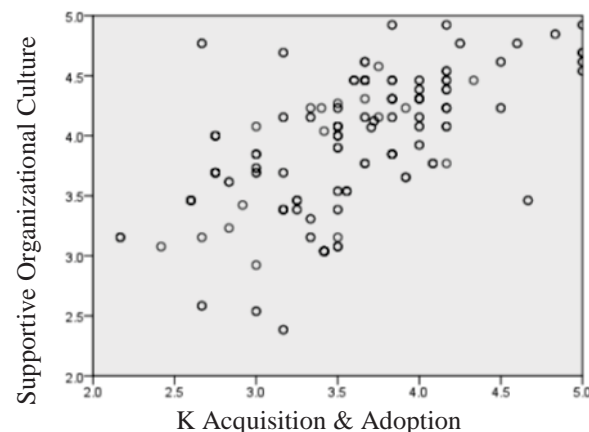
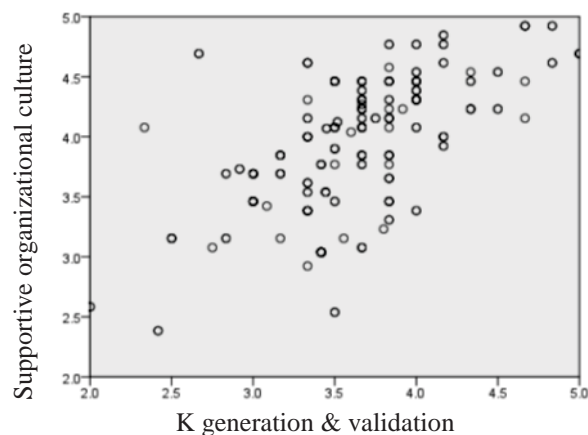
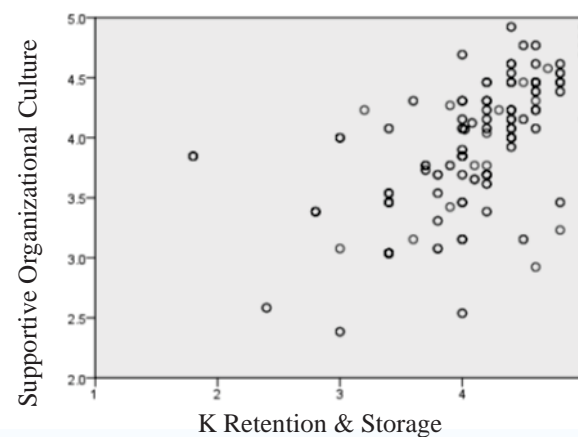
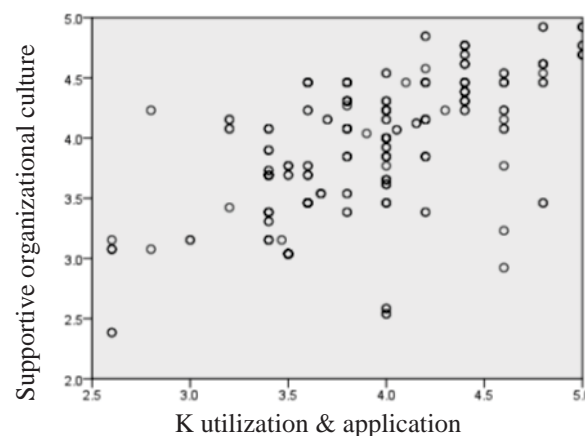
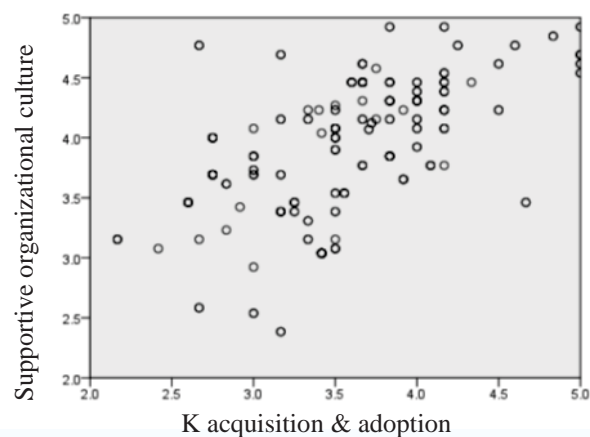
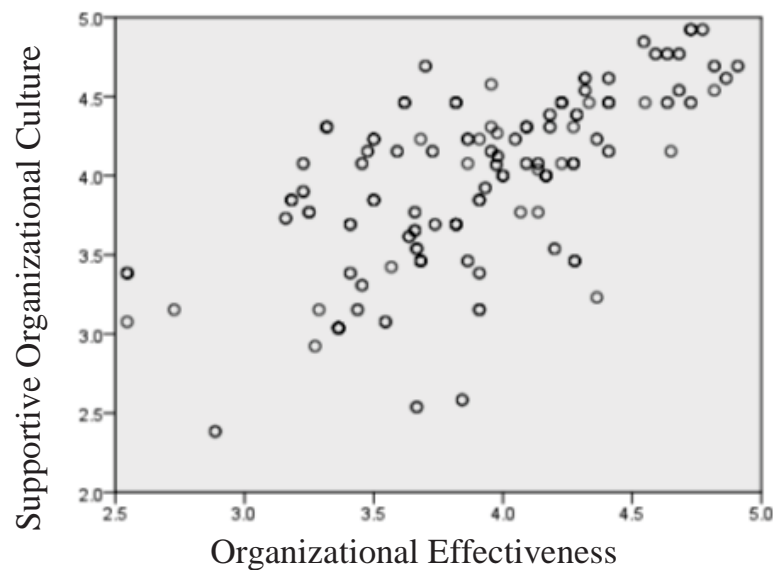


Figure 1. Scatterplot of SOC vs. KR

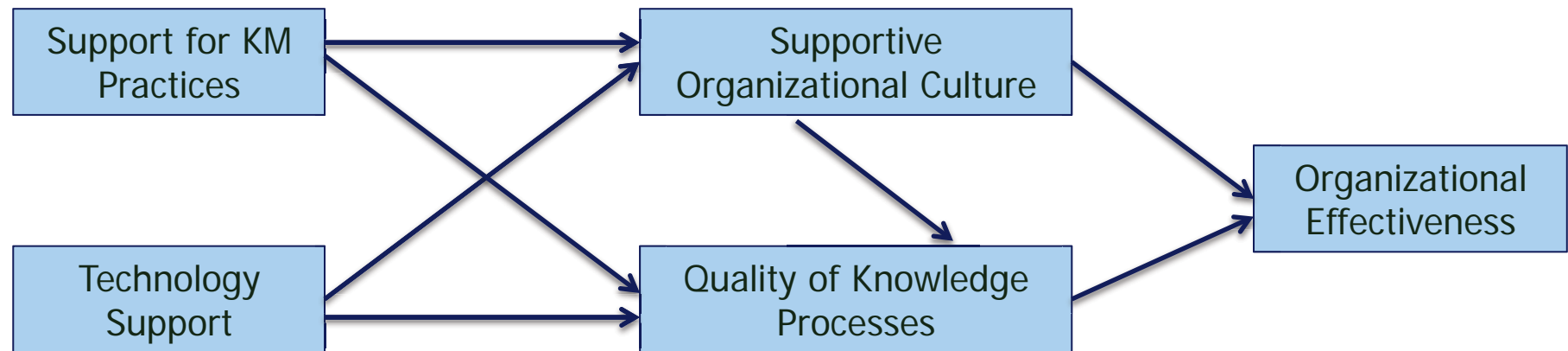


Link between Supportive Organizational Culture and Organizational Effectiveness

Figure 1. Scatterplot of SOC and OE

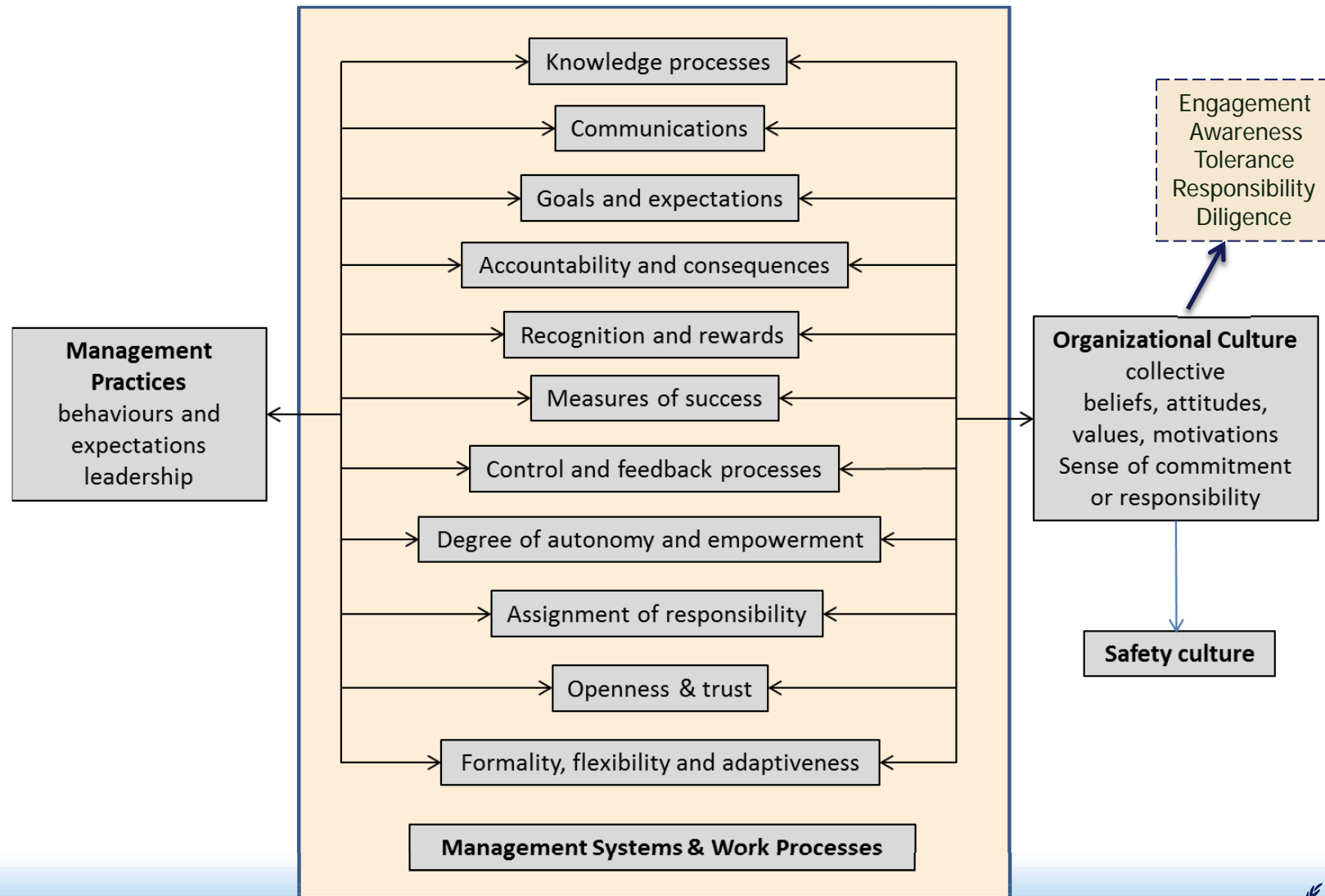


KM Performance Model

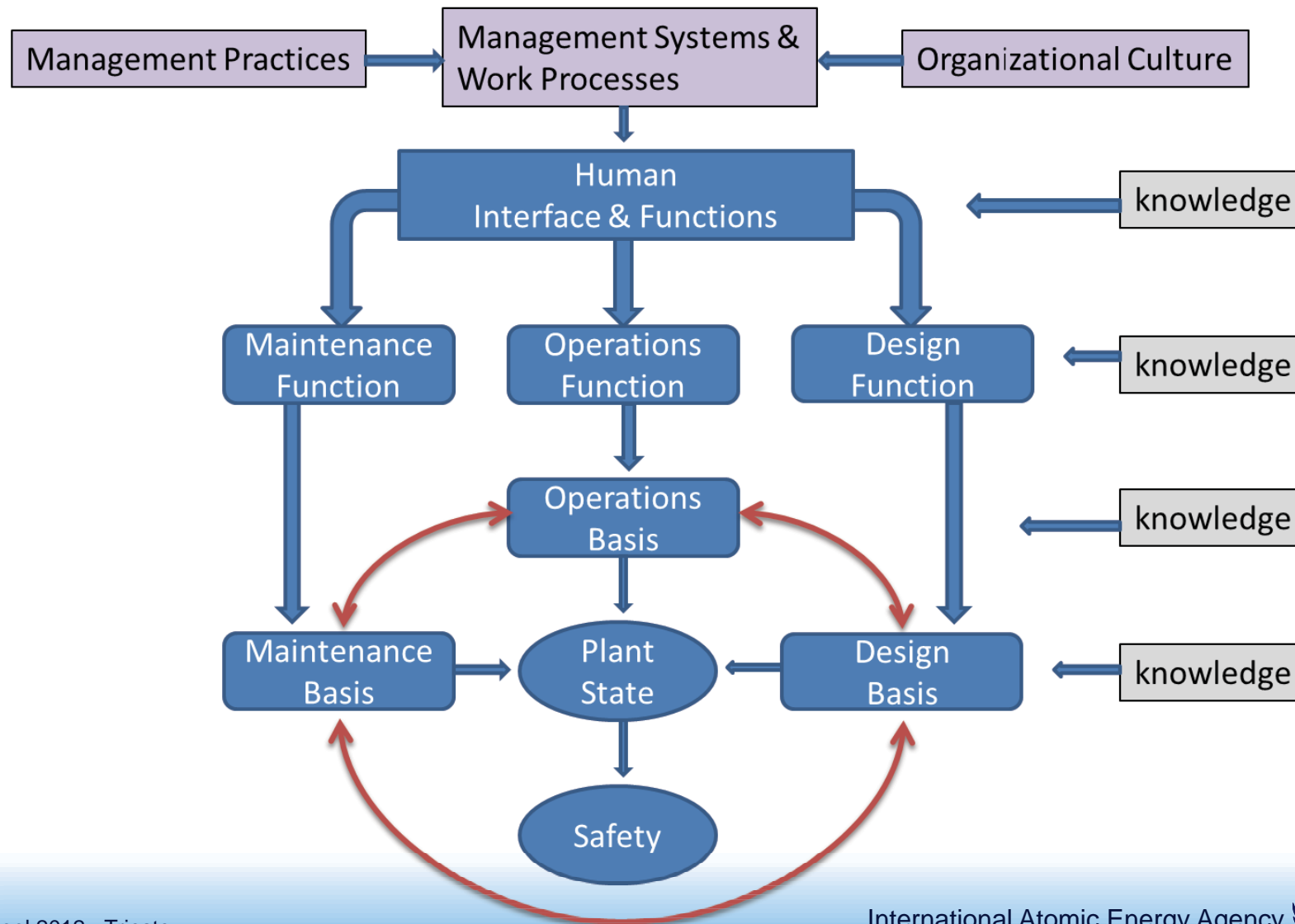


(Ref: de Grosbois, 2011)

The Links between Management Practices and Organizational Culture



Understanding how knowledge impacts safety



NKM accomplishments of the past decade...



**Establishment of the
NKM Subprogram for
Member States**

**Establishment of the
NKM Section**



17 NKM Publications

NEM School 2012 - Trieste

IAEA-TECDOC-1656

*Evaluation of
Human Resource Needs
for a New Nuclear Power Plant:
Armenian Case Study*

IAEA-TECDOC-1399

*The nuclear power industry's
ageing workforce: Transfer of
knowledge to the next generation*

IAEA Nuclear Energy Series

No. NG-T-6.7



**Comparative Analysis
of Methods and
Tools for Nuclear
Knowledge Preservation**

IAEA Nuclear Energy Series

No. NG-T-6.1



**Status and Trends
in Nuclear Education**

IAEA Nuclear Energy Series

No. NG-T-6.3



**Fast Reactor Knowledge
Preservation System:
Taxonomy and
Basic Requirements**

Managing Nuclear Knowledge

IAEA Activities and International Coordination

**Asian Network for Education
in Nuclear Technology
(ANENT)**

July 2007

IAEA Nuclear Energy Series

No. NG-T-6.6

**Web Harvesting for
Nuclear Knowledge
Preservation**

Managing Nuclear Knowledge: Strategies and Human Resource Development

Summary of an international conference

7–10 September 2004, Saclay



Managing Nuclear Knowledge

Proceedings of a Workshop

Managing Nuclear Knowledge

Managing Nuclear Knowledge

Pocket Reference for Executives



RISK MANAGEMENT OF KNOWLEDGE LOSS IN NUCLEAR INDUSTRY ORGANIZATIONS

IAEA-TECDOC-1510

**Knowledge Management
for Nuclear Industry
Operating Organizations**



October 2006

Managing Nuclear Knowledge

IAEA Activities and International Coordination

**The World Nuclear
University:
New Partnership in Nuclear
Education**

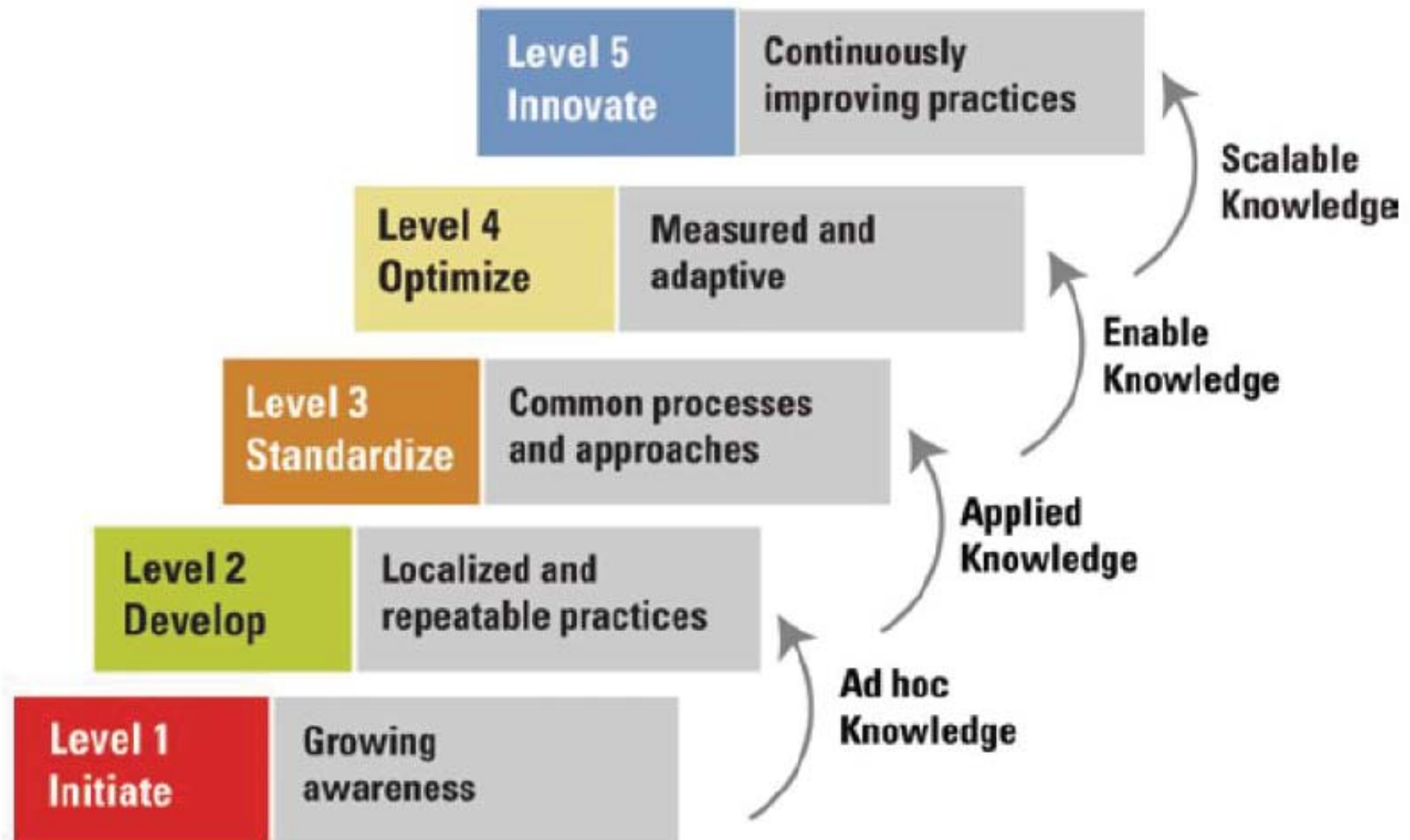
July 2007



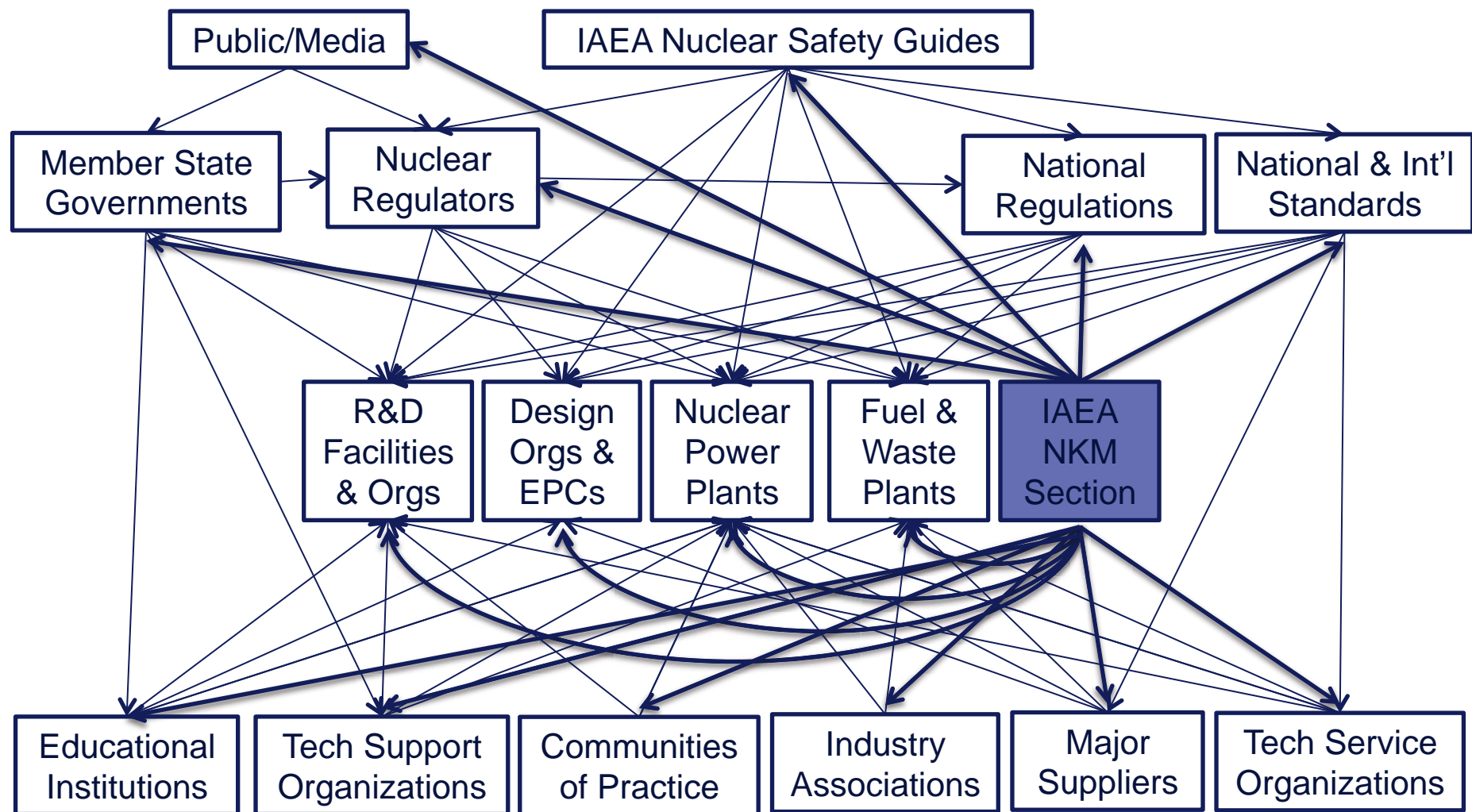
May 2008



APQC'S STAGES OF KNOWLEDGE MANAGEMENT MATURITY



Industry Wide Perspective for NKM



NKM Strategic Path Forward...

- Build on success of current program
- Maintain and build current initiatives
- Expand to meet new needs & opportunities
- Adapt to evolving needs of member states
 - Existing nuclear energy program needs vary
 - Developing nuclear energy program needs vary



**Thank you!
Questions or
comments?**

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